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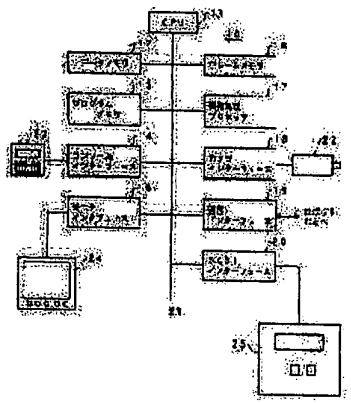
(71)Applicant : FANUC LTD
(72)Inventor : WATANABE ATSUSHI
TERAWAKI BUNICHI
KATSUHISA HIROSHI

(54) IMAGE PROCESSING METHOD FOR INDUSTRIAL VISION SENSOR

(57)Abstract:
PURPOSE: To improve the reliability of the vision sensor by adding data for specifying image data or any relative data to the image data, transferring the image data to an auxiliary storage device and storing them.
CONSTITUTION: An image picked up by a camera 22 is stored in a frame memory 16 after a gray scale gradation processing at an image processor 17. Next, an image processing is executed to the image stored in the frame memory 16 while using teaching data calculated in advance, an object is recognized, and the position and the posture are detected. After such an image processing is executed, the detected position and posture of the object are transformed from the coordinate system of the vision sensor to a robot coordinate system, and transformed information is transmitted through a communication interface 19 to a robot as correction data. The data are successively transferred to an auxiliary storage device 25 and stored there. Further, the data are successively called from the frame memory 16 and reproduced, and the set teaching data are checked.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the image-processing approach in the visual sensor which is used as vision of an industrial robot etc. and performs an object recognition.
[0002]
[Description of the Prior Art] As use of a visual sensor, a visual sensor is included in a production line, and sequential detection of the detection object sent in one by one on a production line with this visual sensor is carried out, the location and posture data of that object are changed into the system of coordinates of machines, such as a robot, it transmits to machines, such as a robot, as amendment data, and making amendment of operation perform based on this amendment data is performed by machines, such as a robot.
[0003] Although the instruction data for processing the image photoed with the camera, recognizing an object, and detecting the location etc. were required in such a system in order to obtain the above-mentioned amendment data, this was set up by detecting the value of the parameter for adjustment from one image (sample) with an object.
[0004]
[Problem(s) to be Solved by the Invention] the detection object with which the instruction data for which it asked as mentioned above are sent to a production line one after another sure enough — receiving — an average thing — when the object which cannot check how it is and is sent to a production line one by one changes a little in connection with the passage of time, since this situation is coped with, it may have to be necessary to change the present instruction data a little For example, even if it obtains the instruction data for finding the hole of a certain components from the sample in the condition that the oil has not adhered, when few oils come to be sent in the condition of having adhered to that hole, from the stage in the

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CLAIMS

(57) [Claim(s)]
[Claim 1] To the image data which photoed the detection object with the camera and was stored in the frame memory Related data, such as a detection value over the data which specifies this image data, or its image data, a program name, calibration data, and amendment data, are added. Using the associated data which reverted to the frame memory from the above-mentioned auxiliary storage unit at the time of subsequent data investigation, and was added in the image data which transmitted and memorized to the auxiliary storage unit and was accumulated in this auxiliary storage unit The display of the restored image data, the image-processing approach in the industrial visual sensor characterized by carrying out reappearance activation of the image-processing processing program.

[Translation done.]

And required discernment is given each time, the image data which photoed with the camera and was stored in the frame memory is transmitted to this auxiliary storage unit, and storage maintenance is carried out here. After activity termination, when carrying out check examination of whether the instruction data set up first were suitable, or when investigating the cause when there is processing failure, the image data saved at the above-mentioned store is transmitted to a frame memory, respectively, and reappearance activation of the former image-processing program is carried out.

[0010]

[Example] Drawing 1 is the important section block diagram of the visual sensor which enforces the approach of this invention. Among drawing, 11 are the main central processing unit (henceforth Maine CPU), and through a bus 21, data memory 12, program memory 13, the console interface 14, the monitor interface 15, a frame memory 16, an image processing processor 17, the camera interface 18, a communication interface 19, and the SCSI interface 20 are connected to this Maine CPU 11, and they constitute the image processing system 10 as a whole in it.

[0011] Data memory 12 consists of nonvolatile RAM, and many data on an image processing, such as instruction data, are memorized here. The application program which a user creates is stored in program memory 13. The console 23 is connected to the console interface 14. Various kinds of command keys and ten keys are attached, and this console 23 operates a data setup and input of an application program, edit, registration, activation, etc. from here. Furthermore, this console is equipped with the display screen and the menu for the contents ordered and operated and a data setup, the list of programs, etc. are displayed. The monitor TV is connected to the monitor interface 15, and the raw image which the image and camera 22 which are stored in the frame memory 16 caught is displayed here.

[0012] The pixel data (sensor system of coordinates) about the object which was photoed by the camera 22 and processed as a gray scale image are stored in a frame memory 16. An image processing processor 17 processes the image stored in the frame memory 16, and an object is identified or it measures the location and a posture. The camera 22 for photoing the object sent one by one on a production line is connected to the camera interface 19. The system (not shown) using vision sensor systems, such as a robot, is connected to the communication interface 19.

[0013] Although the above configuration is the same as the configuration of the conventional visual sensor, especially in this invention, the description is in the place which performs the target image processing by using the visual sensor with which the auxiliary storage unit as external memory was added through the SCSI interface 20. That is, optical-magnetic disc equipment is

components sent to Rhine, this instruction data becomes already suitable [as what detects such a hole] less, and correction of instruction data is needed.

[0005] By the way, in order to judge whether the set-up instruction data fit the present condition, or in order to correct to that which is caused so that the present condition can be coped with, and is reliable, it is required to refer to many processing-by then image data. However, since the memory capacity of a frame memory is restricted extremely, it cannot carry out storage maintenance of many image data in usual. That is, although it is stored in an image memory (frame memory) after gray scale shade processing of the image which the camera photoed based on the snap command is carried out by the image processing processor, one gray scale image in this frame memory is usually 256x256x1 byte, and the number of image data which can memorize a frame memory is about 4-20 from the lim on hardware.

[0006] Furthermore, when failure in processings, such as a detection failure and incorrect detection, arises, although that image that went wrong is examined to investigate this cause, there is need. However, since a visual sensor did not have the means which carries out storage maintenance of this image that went wrong, in this cause investigation, the current line had to interrupt the activity to require, had to catch the object with the camera again, and had to perform the image processing.

[0007] Then, the invention in this application aims at offering the image-processing approach in an industrial visual sensor which conducts cause investigation after activity termination about processing failure while it can obtain the suitable instruction data on the basis of many past image data.

[0008]

[Means for Solving the Problem] This invention to the image data which photoed the detection object with the camera and was stored in the frame memory Related data, such as a detection value over the data which specifies this image data, or its image data, a program name, calibration data and amendment data, are added. Using the associated data which reverted to the frame memory from the above-mentioned auxiliary storage unit at the time of subsequent data investigation, and was added in the image data which enabled it to transmit and memorize to an auxiliary storage unit, and was further accumulated in the above-mentioned auxiliary storage unit in addition to this Solution of this trouble is aimed at by the ability having been made to carry out reappearance activation of the display of the restored image data, and the image-processing processing program.

[0009]

[Function] An auxiliary storage unit is attached in an industrial visual sensor.

investigate whether the set-up instruction data were suitable sure enough to the old image processing, and on what kind of cause detection failure is based again, image input origin is switched to an auxiliary storage unit 25 from a camera 22 by the command from an operator's console.

[0018] Then, an operator calls the image data of that detection is impossible or incorrect detection to a frame memory 16 one by one by projecting the menu which should be carried out call appearance from an auxiliary storage unit, and choosing one of them by the key on the display screen of a console 23, first. And to these image data, after an image processing processor 17 pretreats gray scale shade processing, an image shading off, edge enhancement, etc. one by one, an image-processing program is performed again. And an operator sees the result how come out with a monitor TV 24, and the cause of object detection failure is explored.

[0019] Next, the image data of the object of the arbitration detected normally is called to a frame memory 16 one by one from an auxiliary storage unit 25 by choosing still more nearly another thing from the menu on the screen of a console 23. And an image processing processor 17 carries out sequential execution of the same image-processing program as before about these image data. The processed image is projected on a monitor TV 24. The point (the description data) for pinpointing the location of the object which this visual sensor has recognized in the image on this monitor TV 24 will be displayed on coincidence in that case. For example, in order to recognize the hole of a certain goods, when the visual sensor is used, x point is displayed on the image of an object at the place made into the center position of the hole which this visual sensor has recognized to the monitor TV 24. Then, an operator sees the image of the object projected on the monitor TV 24, and judges whether the image processing is performed correctly. Moreover, [whether the relation between an object and x point was found and the visual sensor has caught the description data correctly, and] That is, even if x point is always correctly located at the core of the hole of goods or it changes x point by small width of face in the various directions to the core of a hole, it judges whether the central point of the fluctuation is in agreement with the core of a hole. Consequently, when the result to satisfy is not obtained, an operator starts for correction of instruction data. Then, an operator sets up new instruction data with a console 23 (temporary construction law). Then, the data is stored in data memory 12. Subsequently, by the key stroke of a console 23, an operator transmits subject-copy image data to a frame memory 16 from an auxiliary storage unit 25 again. and this image data — receiving — the image-processing program according to correction instruction data is given, and that result projects on a monitor TV 24. And an operator repeats correction of the above-mentioned instruction data by trial and error until it sees x point whether come to the core of the

connected to the SCSI interface 20 as an auxiliary storage unit 25. In addition, as for this auxiliary storage unit 25, writing and read-out of data may use storage, such as a high-speed hard disk and an optical disk, similarly in addition to optical-magnetic disc equipment. Moreover, writing and read-out of data may use storage which is low speeds, such as a cassette streamer and DAT. Any [these] store can have the memory capacity of several megabytes or more, and 10,000 or more image data can be saved from thousands of sheets. If especially a high-speed store is used, data can be mostly saved with activation of an image processing at degree coincidence.

[0014] Next, actuation of this example is explained with the flow chart of drawing 2 . If an image-processing starting command is inputted from the exterior through a communication interface 19, Maine CPU 11 will start the image-processing program stored in program memory 13, and will output an image snap command to a camera 22 first. The image which the camera 22 caught is stored in a frame memory 16 after gray scale shade processing is carried out with an image processing processor 17 (step S1). Next, Maine CPU 11 issues an object detection command to an image processing processor 17. Then, an image processing processor 17 performs an image processing using the instruction data for which it asked beforehand from the image stored in the frame memory 16 based on this command, recognizes an object, and performs detection of that location and a posture (step S2).

[0015] In this way, after performing an image processing, the location and posture of the detected object are changed into robot system of coordinates from the system of coordinates of a visual sensor (step S3), and it transmits to a robot through a communication interface 19 by using changed information to write as amendment data (step S4).

[0016] The image data (subject-copy image data) which the camera caught and was stored in the frame memory 16 on the other hand is serially transmitted to an auxiliary storage unit 25 through the SCSI interface 20, and is memorized here each time (step S5). In addition, in case subject-copy image data are saved in this way at an auxiliary storage unit 25, the indicato of the information about the program which processed the image, for example, an image-processing program, a date, a serial number, an actual detection value, amendment data, calibration data, etc. are added. Moreover, when a visual sensor uses two or more cameras, the camera number which captured the image is also added. Furthermore, as for the thing of failure in processings, such as a detection failure, a display to that effect is added. in addition, according to the processing program beforehand given to program memory 13, such additional information is automatically boiled by Maine CPU 11, and is added to subject-copy image data.

[0017] And the production line which was working is stopped, and in order to

TECHNICAL FIELD

[Industrial Application] This invention relates to the image-processing approach in the visual sensor which is used as vision of an industrial robot etc. and performs an object recognition.

[Translation done.]

image of a monitor TV 24, and the hole of an object and the result to satisfy is obtained.

[0020] In this way, while being able to investigate the cause of detection failure about the image processing performed in the past, whether the set-up instruction data was also that of optimum can judge subsequently also to what was detected normally. Similarly the stored detection data can be used and it can check whether amendment data are calculated correctly.

[0021] In addition, although all the images that the camera 22 caught were saved in the above-mentioned example at the auxiliary storage unit 25, it replaces with this, and although all the images of detection failure are saved, you may change as it saves for setting several pieces about what was detected normally.

[0022]

[Effect of the Invention] As mentioned above, since many image data processed by the Rhine halt is saved and it enabled it to reappear according to this invention, evaluation can be carried out [whose set-up instruction data are dependability how much] afterwards about that it would not be. Therefore, the result which could judge whether it should correct to the present setting instruction data in performing an image processing further from now on, and was actually corrected can check using the image data which saved whether it was a suitable thing. Furthermore, since it is reproducible also about detection failure of a visual sensor later even if it does not stop a production line on that spot, the improvement of a vision sensor system can be aimed at and working efficiency can be gathered.

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EFFECT OF THE INVENTION

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PRIOR ART

[Description of the Prior Art] As use of a visual sensor, a visual sensor is included in a production line, and sequential detection of the detection object sent in one by one on a production line with this visual sensor is carried out, the location and posture data of that object are changed into the system of coordinates of machines, such as a robot, it transmits to machines, such as a robot, as amendment data, and making amendment of operation perform based on this amendment data is performed by machines, such as a robot. [0003] Although the instruction data for processing the image photoed with the camera, recognizing an object, and detecting the location etc. were required in such a system in order to obtain the above-mentioned amendment data, this was set up by detecting the value of the parameter for adjustment from one image (sample) with an object.

[Translation done.]

image that went wrong, in this cause investigation, the current line had to interrupt the activity to require, had to catch the object with the camera again, and had to perform the image processing.
[0007] Then, the invention in this application aims at offering the image-processing approach in an industrial visual sensor which conducts cause investigation after activity termination about processing failure while it can obtain the suitable instruction data on the basis of many past image data.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] the detection object with which the instruction data for which it asked as mentioned above are sent to a production line one after another sure enough — receiving — an average thing — when the object which cannot check how it is and is sent to a production line one by one changes a little in connection with the passage of time, since this situation is coped with, it may have to be necessary to change the present instruction data a little For example, even if it obtains the instruction data for finding the hole of a certain components from the sample in the condition that the oil has not adhered, when few oils come to be sent in the condition of having adhered to that hole, from the stage in the components sent to Rhine, this instruction data becomes already suitable [as what detects such a hole] less, and correction of instruction data is needed.
[0005] By the way, in order to judge whether the set-up instruction data fit the present condition, or in order to correct to that which is caused so that the present condition can be coped with, and is reliable, it is required to refer to many processing-by then image data. However, since the memory capacity of a frame memory is restricted extremely, it cannot carry out storage maintenance of many image data in usual. That is, although it is stored in an image memory (frame memory) after gray scale shade processing of the image which the camera photoed based on the snap command is carried out by the image processing processor, one gray scale image in this frame memory is usually 256x256x1 byte, and the number of image data which can memorize a frame memory is about 4-20 from the limit on hardware.
[0006] Furthermore, when failure in processings, such as a detection failure and incorrect detection, arises, although that image that went wrong is examined to investigate this cause, there is need. However, since a visual sensor did not have the means which carries out storage maintenance of this

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OPERATION

[Function] An auxiliary storage unit is attached in an industrial visual sensor. And required discernment is given each time, the image data which photoed with the camera and was stored in the frame memory is transmitted to this auxiliary storage unit, and storage maintenance is carried out here. After activity termination, when carrying out check examination of whether the instruction data set up first were suitable, or when investigating the cause when there is processing failure, the image data saved at the above-mentioned store is transmitted to a frame memory, respectively, and reappearance activation of the former image-processing program is carried out.

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MEANS

[Means for Solving the Problem] This invention to the image data which photoed the detection object with the camera and was stored in the frame memory Related data, such as a detection value over the data which specifies this image data, or its image data, a program name, calibration data, and amendment data, are added. Using the associated data which reverted to the frame memory from the above-mentioned auxiliary storage unit at the time of subsequent data investigation, and was added in the image data which enabled it to transmit and memorize to an auxiliary storage unit, and was further accumulated in the above-mentioned auxiliary storage unit in addition to this Solution of this trouble is aimed at by the ability having been made to carry out reappearance activation of the display of the restored image data, and the image-processing processing program.

[Translation done.]

in the place which performs the target image processing by using the visual sensor with which the auxiliary storage unit as external memory was added through the SCSI interface 20. That is, optical-magnetic disc equipment is connected to the SCSI interface 20 as an auxiliary storage unit 25. In addition, as for this auxiliary storage unit 25, writing and read-out of data may use storage, such as a high-speed hard disk and an optical disk, similarly in addition to optical-magnetic disc equipment. Moreover, writing and read-out of data may use storage which is low speeds, such as a cassette streamer and DAT. Any [these] store can have the memory capacity of several megabytes or more, and 10,000 or more image data can be saved from thousands of sheets. If especially a high-speed store is used, data can be mostly saved with activation of an image processing at degree coincidence.

[0014] Next, actuation of this example is explained with the flow chart of drawing 2 . If an image-processing starting command is inputted from the exterior through a communication interface 19, Maine CPU 11 will start the image-processing program stored in program memory 13, and will output an image snap command to a camera 22 first. The image which the camera 22 caught is stored in a frame memory 16 after gray scale shade processing is carried out with an image processing processor 17 (step S1). Next, Maine CPU 11 issues an object detection command to an image processing processor 17. Then, an image processing processor 17 performs an image processing using the instruction data for which it asked beforehand from the image stored in the frame memory 16 based on this command, recognizes an object, and performs detection of that location and a posture (step S2).

[0015] In this way, after performing an image processing, the location and posture of the detected object are changed into robot system of coordinates from the system of coordinates of a visual sensor (step S3), and it transmits to a robot through a communication interface 19 by using changed information to write as amendment data (step S4).

[0016] The image data (subject-copy image data) which the camera caught and was stored in the frame memory 16 on the other hand is serially transmitted to an auxiliary storage unit 25 through the SCSI interface 20, and is memorized here each time (step S5). In addition, in case subject-copy image data are saved in this way at an auxiliary storage unit 25, the indicator of the information about the program which processed the image, for example, an image-processing program, a date, a serial number, an actual detection value, amendment data, calibration data, etc. are added. Moreover, when a visual sensor uses two or more cameras, the camera number which captured the image is also added. Furthermore, as for the thing of failure in processings, such as a detection failure, a display to that effect is added. in addition, according to the processing program beforehand given to program

EXAMPLE

[Example] Drawing 1 is the important section block diagram of the visual sensor which enforces the approach of this invention. Among drawing, 11 are the main central processing unit (henceforth Maine CPU), and through a bus 21, data memory 12, program memory 13, the console interface 14, the monitor interface 15, a frame memory 16, an image processing processor 17, the camera interface 18, a communication interface 19, and the SCSI interface 20 are connected to this Maine CPU 11, and they constitute the image processing system 10 as a whole in it.

[0011] Data memory 12 consists of nonvolatile RAM, and many data on an image processing, such as instruction data, are memorized here. The application program which a user creates is stored in program memory 13. The console 23 is connected to the console interface 14. Various kinds of command keys and ten keys are attached, and this console 23 operates a data setup and input of an application program, edit, registration, activation, etc. from here. Furthermore, this console is equipped with the display screen and the menu for the contents ordered and operated and a data setup, the list of programs, etc. are displayed. The monitor TV is connected to the monitor interface 15, and the raw image which the image and camera 22 which are stored in the frame memory 16 caught is displayed here.

[0012] The pixel data (sensor system of coordinates) about the object which was photoed by the camera 22 and processed as a gray scale image are stored in a frame memory 16. An image processing processor 17 processes the image stored in the frame memory 16, and an object is identified or it measures the location and a posture. The camera 22 for photoing the object sent one by one on a production line is connected to the camera interface 19. The system (not shown) using vision sensor systems, such as a robot, is connected to the communication interface 19.

[0013] Although the above configuration is the same as the configuration of the conventional visual sensor, especially in this invention, the description is

correction instruction data is given, and that result projects on a monitor TV 24. And an operator repeats correction of the above-mentioned instruction data by trial and error until it sees x point whether come to the core of the image of a monitor TV 24, and the hole of an object and the result to satisfy is obtained.

[0020] In this way, while being able to investigate the cause of detection failure about the image processing performed in the past, whether the set-up instruction data was also that of optimum can judge subsequently also to what was detected normally. Similarly the stored detection data can be used and it can check whether amendment data are calculated correctly.

[0021] In addition, although all the images that the camera 22 caught were saved in the above-mentioned example at the auxiliary storage unit 25, it replaces with this, and although all the images of detection failure are saved, you may change as it saves for setting several pieces about what was detected normally.

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memory 13, such additional information is automatically boiled by Maine CPU 11, and is added to subject-copy image data.

[0017] And the production line which was working is stopped, and in order to investigate whether the set-up instruction data were suitable sure enough to the old image processing, and on what kind of cause detection failure is based again, image input origin is switched to an auxiliary storage unit 25 from a camera 22 by the command from an operator's console.

[0018] Then, an operator calls the image data of that detection is impossible or incorrect detection to a frame memory 16 one by one by projecting the menu which should be carried out call appearance from an auxiliary storage unit, and choosing one of them by the key on the display screen of a console 23, first. And to these image data, after an image processing processor 17 pretreats gray scale shade processing, an image shading off, edge enhancement, etc. one by one, an image-processing program is performed again. And an operator sees the result how come out with a monitor TV 24, and the cause of object detection failure is explored.

[0019] Next, the image data of the object of the arbitration detected normally is called to a frame memory 16 one by one from an auxiliary storage unit 25 by choosing still more nearly another thing from the menu on the screen of a console 23. And an image processing processor 17 carries out sequential execution of the same image-processing program as before about these image data. The processed image is projected on a monitor TV 24. The point (the description data) for pinpointing the location of the object which this visual sensor has recognized in the image on this monitor TV 24 will be displayed on coincidence in that case. For example, in order to recognize the hole of a certain goods, when the visual sensor is used, x point is displayed on the image of an object at the place made into the center position of the hole which this visual sensor has recognized to the monitor TV 24. Then, an operator sees the image of the object projected on the monitor TV 24, and judges whether the image processing is performed correctly. Moreover, [whether the relation between an object and x point was found and the visual sensor has caught the description data correctly, and] That is, even if x point is always correctly located at the core of the hole of goods or it changes x point by small width of face in the various directions to the core of a hole, it judges whether the central point of the fluctuation is in agreement with the core of a hole. Consequently, when the result to satisfy is not obtained, an operator starts for correction of instruction data. Then, an operator sets up new instruction data with a console 23 (temporary construction law). Then, the data is stored in data memory 12. Subsequently, by the key stroke of a console 23, an operator transmits subject-copy image data to a frame memory 16 from an auxiliary storage unit 25 again. and this image data — receiving — the image-processing program according to

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram of the visual sensor for carrying out one example of the approach of this invention.
[Drawing 2] It is an operation flow chart about one example of the approach of this invention.
[Description of Notations]
10 Image Processing System
11 Central Processing Unit (Maine CPU)
12 Data Memory
13 Program Memory
14 Console Interface
15 Monitor Interface
16 Frame Memory
17 Image Processing Processor
18 Camera Interface
19 Communication Interface
20 SCSI Interface
21 Bus
22 Camera
23 Console
24 Monitor TV

[Translation done.]

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(73)特許権者　390008235
ファナック株式会社
山梨県南都留郡忍野村忍草字古馬場3580番地

(72)発明者　渡辺　淳
山梨県南都留郡忍野村忍草字古馬場3580番地　ファナック株式会社　商品開発研究所　内

(72)発明者　寺脇　文一
山梨県南都留郡忍野村忍草字古馬場3580番地　ファナック株式会社　商品開発研究所　内

(74)代理人　弁理士　竹本　松司　(外２名)

審査官　後藤　彰

最終頁に続く

(54)【発明の名称】　産業用視覚センサにおける画像処理方法

(57)【特許請求の範囲】

【請求項１】　検出対象物をカメラで撮影しフレームメモリに格納した画像データに、該画像データを特定するデータ、或いはその画像データに対する検出値、プログラム名、キャリブレーションデータ、補正データなど、関連するデータを付加して、補助記憶装置に転送し記憶し、該補助記憶装置に蓄積した画像データを、その後のデータ調査時に、上記補助記憶装置からフレームメモリに復元し、付加された関連データを利用しながら、復元した画像データの表示、画像処理処理プログラムを再現実行するようにしたことを特徴とする産業用視覚センサにおける画像処理方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】この発明は、産業用ロボット等の

視覚として利用されて物体認識を行う視覚センサにおける画像処理方法に関する。

【０００２】

【従来の技術】視覚センサの利用として、製造ラインに視覚センサを組み入れ、該視覚センサで製造ライン上に順次送り込まれてくる検出対象物を順次検出し、その対象物の位置・姿勢データをロボット等の機械の座標系に変換し、補正データとしてロボット等の機械に送信し、ロボット等の機械ではこの補正データに基づいて動作補正を行わせることが行われている。

【０００３】このようなシステムにおいて、上記補正データを得るためには、カメラで撮影した画像を処理して対象物を認識しその位置等を検出するための教示データが必要であるが、これは、対象物のある１つの画像（サンプル）から調整用のパラメータの値を検出することに

よって設定していた。

【０００４】

【発明が解決しようとする課題】上記のようにして求めた教示データが果たして製造ラインに次々と送られてくる検出対象物に対して平均的なものどうかは確認することができず、又、製造ラインに順次送られてくる対象物が時間の経過に伴ない幾分変化してくるような場合には、この事態に対応するため現在の教示データを若干変更しなければならない必要が生じてくることもある。例えば、ある部品の穴を見付けるための教示データを油が付着してない状態のサンプルから得ても、ラインに送られてくる部品にある時期から僅かの油がその穴に付着した状態で送られてくるようになったときは、この教示データはもはやこのような穴を検出するものとして適切なものではなくなり、教示データの修正が必要になってくる。

【０００５】ところで、設定した教示データが現状に適応しているかどうかを判断するためには、或いは現状に対処し得るようより信頼性のあるものに修正するためには、それまでに処理したの画像データを数多く参照してみることが必要である。しかしながら、フレームメモリの記憶容量はきわめて限られているため、多くの画像データを通常では記憶保持することはできない。すなわち、スナップ指令に基づきカメラが撮影した像は、画像処理プロセッサによりグレイスケール濃淡処理されてから画像メモリ（フレームメモリ）に格納されるが、このフレームメモリ中のグレイスケール画像１枚は通常は256 ×256 ×１バイトであり、フレームメモリが記憶できる画像データ数は、ハードウエア上の制限から、４～２０枚程度である。

【０００６】さらに、検出不可や誤検出等の処理の失敗が生じたときは、この原因を調査するにはその失敗した画像について検討するが必要がある。しかしながら、この失敗した画像を記憶保持する手段を視覚センサは持たないため、この原因調査にあたっては現在行っている作業を中断して、再度対象物をカメラでとらえて画像処理を行わなければならなかった。

【０００７】そこで、本願発明は、過去の多くの画像データを基礎にした適切な教示データを得ることができると共に、処理失敗については作業終了後に原因調査できるような、産業用視覚センサにおける画像処理方法を提供することを目的とする。

【０００８】

【課題を解決するための手段】本発明は、検出対象物をカメラで撮影しフレームメモリに格納した画像データに、該画像データを特定するデータ、或いはその画像データに対する検出値、プログラム名、キャリブレーションデータ、補正データなど、関連するデータを付加して、補助記憶装置に転送し記憶できるようにし、さらにこれに加え、上記補助記憶装置に蓄積した画像データ

を、その後のデータ調査時に、上記補助記憶装置からフレームメモリに復元し、付加された関連データを利用しながら、復元した画像データの表示、画像処理処理プログラムを再現実行できるようにしたことによって、この問題点の解決を図ったものである。

【０００９】

【作用】産業用視覚センサに補助記憶装置を取付ける。そして、カメラで撮影しフレームメモリに格納した画像データは、その都度、必要な識別が与えられて、この補助記憶装置に転送されてここに記憶保持される。作業終了後に、最初に設定した教示データが適切なものであったかどうかを確認検討するとき、或いは処理失敗があったときのその原因を調査するときには、上記記憶装置に保存してある画像データをそれぞれフレームメモリに転送して、以前の画像処理プログラムを再現実行する。

【００１０】

【実施例】図１は、本発明の方法を実施する視覚センサの要部ブロック図である。図中、１１は主中央処理装置（以下、メインＣＰＵという）で、このメインＣＰＵ１１には、バス２１を介して、データメモリ１２、プログラムメモリ１３、コンソールインタフェース１４、モニタインタフェース１５、フレームメモリ１６、画像処理プロセッサ１７、カメラインタフェース１８、通信インタフェース１９、ＳＣＳＩインタフェース２０が接続されて、全体として画像処理装置１０を構成している。

【００１１】データメモリ１２は不揮発性ＲＡＭで構成されて、教示データ等画像処理上の諸データがここに記憶される。プログラムメモリ１３にはユーザが作成するアプリケーションプログラムが格納されている。コンソールインタフェース１４にはコンソール２３が接続されている。このコンソール２３は各種の指令キーやテンキーが付いていて、ここからデータ設定、及びアプリケーションプログラムの入力、編集、登録、実行等の操作を行う。さらに、このコンソールには表示画面が備えてあって、指令・操作した内容、データ設定のためのメニュー、及びプログラムのリスト等が表示されるようになっている。モニタインタフェース１５にはモニタテレビが接続されていて、ここにフレームメモリ１６に格納されている画像及びカメラ２２がとらえた生の映像が表示される。

【００１２】フレームメモリ１６には、カメラ２２に撮影されグレイスケール画像として処理された対象物についての画素データ（センサ座標系）が格納される。画像処理プロセッサ１７はフレームメモリ１６に格納された画像を処理して、対象物の識別をしたり、その位置、姿勢を計測する。カメラインタフェース１９には製造ライン上に順次送られてくる対象物を撮影するためのカメラ２２が接続されている。通信インタフェース１９にはロボット等の視覚センサシステムを利用するシステム（図示せず）が接続されている。

【００１３】以上の構成は従来の視覚センサの構成と同様であるが、本発明では特にＳＣＳＩインタフェース２０を介して外部メモリとしての補助記憶装置が付加された視覚センサを用いることにより、目的とする画像処理を実行するところに特徴がある。すなわち、ＳＣＳＩインタフェース２０には補助記憶装置２５として光磁気ディスク装置が接続されている。なお、この補助記憶装置２５は光磁気ディスク装置に限らず、同様にデータの書き込み・読み出しが高速であるハードディスク、光ディスク等の記憶装置を用いてもよい。また、データの書き込み・読み出しが低速であるカセットストリーマ、ＤＡＴ等の記憶装置を用いてもよい。これらいずれの記憶装置も数メガバイト以上の記憶容量を持ち、画像データを数千枚から１万枚以上保存することができる。特に高速の記憶装置を用いると画像処理の実行とほぼ度同時にデータの保存を行うことができる。

【００１４】次に本実施例の動作を図２のフローチャートと共に説明する。通信インタフェース１９を介して外部から画像処理起動指令が入力されると、メインＣＰＵ１１はプログラムメモリ１３に格納された画像処理プログラムを起動し、まずカメラ２２に対して画像スナップ指令を出力する。カメラ２２がとらえた像は、画像処理プロセッサ１７でグレイスケール濃淡処理されてからフレームメモリ１６に格納される（ステップＳ１）。次に、メインＣＰＵ１１は、画像処理プロセッサ１７に対して対象物検出指令を出す。すると画像処理プロセッサ１７はこの指令に基づき、フレームメモリ１６に格納された画像に対し予め求めておいた教示データを用いて画像処理を行って、対象物を認識し、その位置、姿勢の検出を実行する（ステップＳ２）。

【００１５】こうして画像処理を実行した後は、検出した対象物の位置・姿勢を視覚センサの座標系からロボット座標系に変換し（ステップＳ３）、かく変換した情報を補正データとして通信インタフェース１９を介してロボットに送信する（ステップＳ４）。

【００１６】一方、カメラがとらえフレームメモリ１６に格納した画像データ（原画像データ）はその都度、ＳＣＳＩインタフェース２０を介して補助記憶装置２５に逐次転送され、ここに記憶される（ステップＳ５）。なお、こうして原画像データが補助記憶装置２５に保存される際には、その画像を処理したプログラムに関する情報、例えば画像処理プログラムの標識、日付け、シリアル番号、実際の検出値、補正データ、キャリブレーションデータ等が付加される。また、視覚センサが複数のカメラを使用したときは、その画像を取り込んだカメラ番号も付加される。さらに、検出不可等処理の失敗のものはその旨の表示が付加される。なお、これらの付加情報は、プログラムメモリ１３に予め与えておいた処理プログラムにしたがって、メインＣＰＵ１１により自動的にに原画像データに付加される。

【００１７】そして、稼働していた製造ラインを停止させて、設定した教示データがこれまでの画像処理に対し果たして適切なものであったかどうか、また、検出失敗はいかなる原因に基づくのかを調査するには、オペレータのコンソールからの指令により画像入力元をカメラ２２から補助記憶装置２５に切換える。

【００１８】そこでオペレータはまず、コンソール２３の表示画面上に補助記憶装置から呼び出すべきメニューを映し出し、その内の１つをキーで選択することにより、検出不可或いは誤検出の画像データをフレームメモリ１６に順次呼び出す。そして、これら画像データに対し、順次画像処理プロセッサ１７がグレイスケール濃淡処理、画像ぼかし、エッジ強調等の前処理を行ったうえで再度画像処理プログラムを実行する。そして、その結果がどのように出るかをオペレータはモニタテレビ２４でみて、対象物検出失敗の原因を探る。

【００１９】次に、コンソール２３の画面上のメニューからさらに別のものを選択することによって、正常に検出された任意の対象の画像データを補助記憶装置２５から１つ１つフレームメモリ１６に呼び出す。そして、これら画像データについて画像処理プロセッサ１７は以前と同じ画像処理プログラムを順次実行する。その処理した画像はモニタテレビ２４に映し出される。その際、このモニタテレビ２４上の画像には、この視覚センサが認識した対象物の位置を特定するための点（特徴データ）が同時に表示されることになる。例えば、ある物品の穴を認識するために視覚センサが利用されているときには、モニタテレビ２４には該視覚センサが認識した穴の中心位置とするところに×点が対象物の像の上に表示される。そこで、オペレータはモニタテレビ２４に映し出された対象物の像をみて画像処理が正しく行われているかどうかを判断し、また対象物と×点との関係をみて、視覚センサが特徴データを正しくとらえているかどうか、すなわち物品の穴の中心に常に×点が正確に位置するか、或いは×点が穴の中心に対していろいろな方向に小さい幅で変動してもその変動の中心点は穴の中心に一致しているかどうか等を判断する。その結果、満足する結果が得られなかった場合には、オペレータは教示データの修正作業にとりかかる。そこで、オペレータはコンソール２３により新たな教示データを設定（仮設定）する。するとそのデータはデータメモリ１２に格納される。次いでオペレータはコンソール２３のキー操作によって、再び補助記憶装置２５から原画像データをフレームメモリ１６に転送する。そして、この画像データに対しは修正教示データに従った画像処理プログラムが施され、その結果がモニタテレビ２４に映し出される。そして、オペレータは、モニタテレビ２４の像及び対象物の穴の中心に×点が来るかどうかをみて、満足する結果が得られるまで上記教示データの修正作業を試行錯誤的に繰り返す。

7

【００２０】こうして、過去に行った画像処理について、検出失敗の原因を調査できると共に、正常に検出していたものに対しても、その設定した教示データが最適のものであったかどうかが事後に判断できるようになる。同様にして、格納された検出データ等を使い、補正データが正しく計算されているか確認することができる。

【００２１】なお、上記実施例では、カメラ２２がとらえた画像を全て補助記憶装置２５に保存するようにしたが、これに代えて、検出失敗の画像は全て保存するが、正常に検出したものについては何個かおきに保存するというように変更してもよい。

【００２２】

【発明の効果】以上のように、本発明によれば、ライン停止までに処理した数多くの画像データを保存しかつ再現できるようにしたので、設定した教示データがどの程度信頼性の有ったものかということについて後から評価をすることができる。したがって、今後さらに画像処理を実行するにあたっては現在の設定教示データに修正を施すべきかどうかが判断でき、また、実際に修正した結果が適切なものかどうかを保存した画像データを用いて確認してみることができる。さらに、視覚センサの検出失敗についても、その場で製造ラインを停止しなくても、後で再現できるので、視覚センサシステムの改善が＊

8

＊図れて、作業効率を上げることができる。

【図面の簡単な説明】

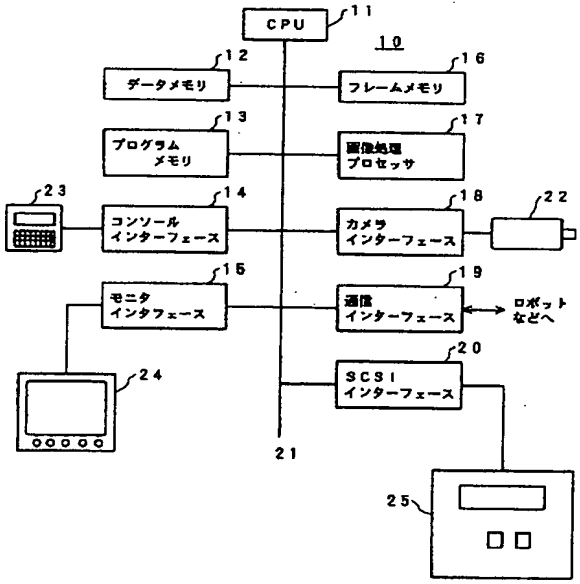
【図１】本発明の方法の１実施例を実施するための視覚センサのブロック図である。

【図２】本発明の方法の１実施例についての動作フローチャートである。

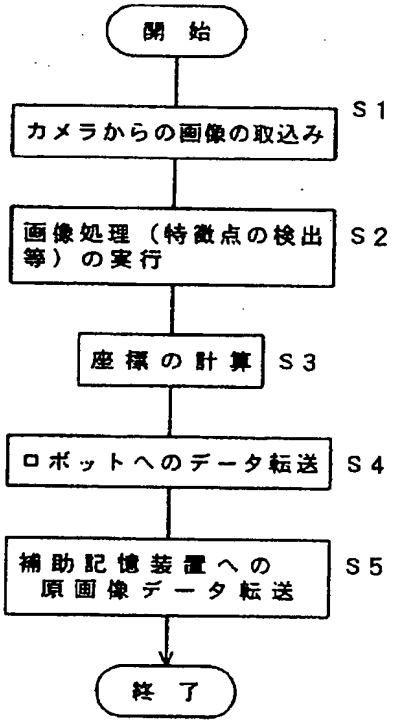
【符号の説明】

１０　画像処理装置
１１　中央処理装置（メインＣＰＵ）
１２　データメモリ
１３　プログラムメモリ
１４　コンソールインタフェース
１５　モニタインタフェース
１６　フレームメモリ
１７　画像処理プロセッサ
１８　カメラインタフェース
１９　通信インタフェース
２０　ＳＣＳＩインタフェース
２１　バス
２２　カメラ
２３　コンソール
２４　モニタテレビ

【図１】



【図２】



フロントページの続き

(72)発明者　勝久　洋
山梨県南都留郡忍野村忍草字古馬場3580番地　ファナック株式会社　商品開発研究所　内

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